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(54) Method of making a high pressure condenser

Verfahren zur Herstellung eines Hochdruckverdichters

Méthode de fabrication d'un condenseur à haute pression

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Description

This invention relates to a method of making a high pressure heat condenser.

Background and Summary of the Invention

In the manufacture of heat exchangers and particularly high pressure heat exchangers, known as condensers, one of the problems is the high pressure of the material handled such as refrigerant requires either that the tubes utilized in the condenser be thick or be extruded with sufficient thickness to provide multiple paths that have the adequate strength.

The tubes must be reinforced or the walls thereof thickened.

Thus, in one commercial form which has been utilized, it is common to provide a plurality of flat extruded tubes that have longitudinally extending channels for the refrigerant, headers at each end or the tubes which are bonded to the tubes and a plurality of sheets having openings through which the tubes extend to provide fins.

Another prior art method, according to the pre-characterising part of claim 1, is known from US-A-5172476.

Summary of the Invention

The objective of the present invention is to provide an alternative method of making the condenser.

This objective is realised by the method according to claim 1.

In accordance with one preferred embodiment of the invention, a high pressure condenser comprises a plurality of transversely spaced flattened tubes having their ends extending into headers at each end to the tubes and a plurality of undulating fins extending between adjacent tubes. The tubes are made by utilizing flat strip stock that is coated on both surfaces with a coating that will fuse and bond on the application of heat and has a plurality of longitudinally and transversely spaced deformed portions or projections. The flat strip stock is subjected to the steps of first rolling the opposite edges of the strip into a curved configuration having a radius corresponding to the radius of curvature desired preferably on the rounded longitudinally welded edge of the tube, then progressively rolling the central portion of the strip into the rounded configuration desired along the other longitudinal edge of the tube while utilizing the rounded free edge portions and the center bend to accurately center the strip as it advances through the successive forming rolls and, thereafter heating the spaced free edges of the rolled strip to a temperature at which they are adapted to be fused together and directing them through a guide located upstream from and directly adjacent a pair of squeeze rolls for effecting a weld seam therebetween, the guide being designed to engage each free edge portion of the

strip on laterally opposite sides thereof. The projections in the strip are brought into engagement before the free edges of the rolled strip are fused together. When the tubes are assembled with the fins to the headers, the entire assembly is subjected to heat to cause the coating on the surfaces of the tubes to bond the projections to one another and to bond the exterior of the tubes to the slots in the headers through which the ends of the tubes extend.

Description of the Drawings

FIG. 1 is a part sectional elevational view of a condenser taken along the line 1-1 in FIG. 2.

FIG. 2 is a sectional view taken along the line 2-2 in FIG. 1.

FIG. 3 is a sectional view taken along the line 3-3 in FIG. 1.

FIG. 4 is a plan view of a tube utilized in the condenser shown in FIGS. 1-3.

FIG. 5 is an end view taken along the line 5-5 in FIG. 4.

FIG. 6 is a fragmentary view on an enlarged scale of the portion shown in the circle 6 in FIG. 5.

FIG. 7 is a fragmentary plan view of a modified form of tube.

FIG. 8 is an end view taken along the line 8-8 in FIG. 7.

FIG. 9 is a fragmentary view on an enlarged scale in the circle shown in FIG. 9 of FIG. 8.

FIG. 10 is a fragmentary plan view of further modified form of tube.

FIG. 11 is a sectional view taken along the line 11-11 in FIG. 10.

FIG. 12 is a fragmentary view on an enlarged scale of a portion of the tube shown in FIG. 11.

FIG. 13 is a fragmentary plan view of a further modified form of tube.

FIG. 14 is a fragmentary sectional view of a modified form of condenser.

FIG. 15 is a fragmentary sectional view taken along the line 15-15 in FIG. 14.

FIG. 16 is a fragmentary view taken along the line 16-16 in FIG. 14.

FIG. 17 is a schematic view showing the progressive cross sectional configuration of the strip stock as it is formed into the finished tube.

Description

Referring to FIGS. 1-6, the high pressure condenser 20 comprises a plurality of parallel transversely spaced flattened tubes 21 with undulating heat exchange fins 22 therebetween extending along the length of the tubes 21. The ends of the tubes 21 extend through slots having the cross section of the tubes into tubular headers 23 that have end caps 24.

The various components are made of metal having

a coating on the inner and outer surfaces thereof which will fuse and bond upon application of heat. For example, in the case of aluminum the coating may comprise cladding. In the case of copper or brass the coating may comprise solder, the tubes 21 have a coating on both the interior and exterior as presently described.

As shown in FIGS. 4-6 the tubes 21 have a plurality of longitudinally extending indentations 25 which define projections 25 that abut one another and are fused to one another by the coating on the inner surface at C. The tubes are formed by progressively rolling a strip to bring the ends of the tube into engagement so that they are fused at S when the tube is heated. The exterior surface of the tube is bonded to the header 23 and the fins 22 through the coating upon application of heat to the assembly, as do the fins 22.

In the forms shown in FIGS. 7-9, the tubes 21a have flattened abutting portions 25a which are similarly bonded.

In the form shown in FIG. 10 longitudinally and transversely spaced indentations 25b which are frusto-conical are in abutment on the tubes 21b in the tube 21c shown in FIG. 13, the indentations 25c on the outer rows are staggered with respect to indentations 25c in an inner row.

In the form shown in FIGS. 14-16, each tube 21d has two rows of longitudinally spaced indentations 25d.

The tubes are made from strip stock which is coated with a coating on the inner and outer surfaces that will bond at high temperature, the coating being applied to surfaces of the strip. The method comprises the steps of first rolling the opposite edges of the strip into a curved configuration having a radius corresponding to the radius of curvature desired on the rounded longitudinally welded edge of the tube, then progressively rolling the central portion of the strip into the rounded configuration desired along the other longitudinal edge of the tube while utilizing the rounded free edge portions and the center bend to accurately center the strip as it advances through the successive forming rolls and, thereafter heating the spaced free edges of the rolled strip to a temperature at which they are adapted to be fused together and directing them through a guide located upstream from and directly adjacent a pair of squeeze rolls for effecting a weld seam therebetween, the guide being designed to engage each free edge portion of the strip on laterally opposite sides thereof. The projections in the strip are brought into engagement before the free edges of the rolled strip are fused together. When the tubes are assembled with the fins to the headers, the entire assembly is subjected to heat to cause the coating on the surfaces of the tubes to bond the inner surface of the projections to one another and to bond the exterior of the tubes to the slots in the headers through which the ends of the tubes extend. The strip is progressively rolled after the indentations are formed therein and an additional rolling step is provided wherein initially the

opposite edges of the flat strip are rolled by restraining the free ends of the side edges and bending the side edges into a configuration comprising flat side edge portions connected by a radius portion to the central flat portion of the strip and extending at an acute angle to the flat central portion of the strip. This partially curved configuration serves as a guide to accurately position the strip as it moves into the next step of rolling the opposite flat edge portions of the strip into a curved configuration having a radius corresponding to the radius of curvature desired on the rounded longitudinally welded edge of the tube. The strip is then moved through the successive steps of progressively rolling the central portion of the strip into the rounded configuration desired along the other longitudinal edge of the tube while utilizing the rounded free edge portions and the center bend to accurately center the strip as it advances through the successive forming rolls and, thereafter heating the spaced free edges of the rolled strip to a temperature at which they are adapted to be fused together and directing them through a guide located upstream from the directly adjacent a pair of squeeze rolls for effecting a weld seam therebetween, the guide being designed to engage each free edge portion of the strip on laterally opposite sides thereof.

As previously indicated after the tubes are formed and the free edges of the strip are bonded to one another by localized heating, the tubes, fins and headers are assembled and the entire assembly is then subjected to heat to cause the exterior surface of the ends of the tubes to be bonded to the headers, the fins to be bonded to the tubes and the indentations to be bonded to one another by the coating on the interior of the tubes.

It can thus be seen there has been provided a method of making a high pressure condenser which can be made of lightweight material.

Claims

1. A method of forming a high pressure condenser (20) comprising a plurality of flattened tubes (21) having two longitudinally extending rounded edges, the ends of which extend into slots in a header (23) whereby the flattened tubes (21) are made by roll-forming flat strip stock, which has a coating on both surfaces, the method characterised by

forming spaced indentations (25; 25a; 25b; 25c; 25d) in said strip, which result in projections on the opposite side thereof, subjecting the strip to the steps of

first rolling the opposite edges of the strip into a curved configuration having a radius corresponding to the radius of curvature desired on one rounded edge of a tube, then progressively rolling the central por-

tion of the strip into the rounded configuration, desired along the other longitudinal edge of the tube while utilizing the rounded edge portions and the center portion to accurately center the strip as it is advanced through the successive forming rolls,

thereafter heating the spaced free edges of the rolled strip to a temperature at which the edges will fuse together and directing them through a guide located upstream from and directly adjacent a pair of squeeze rolls for effecting one or more weld seams therebetween, the guide being designed to engage each free edge portion of the strip on laterally opposite edges thereof,

bringing opposed projections in the strip into abutting engagement,

and assembling the tubes (21) with the fins (22) to the headers (23) with the ends of the tubes (21) extending into slots into the headers (23),

subjecting the entire assembly to heat to cause the coating on the surfaces of the tubes to bond the projections to one another, to bond the exterior of the tubes to the slots in the headers (23) through which the tubes (21) extend, and to bond the fins (22) in the tubes (21).

2. The method set forth in claim 1 wherein said step of forming indentations comprises forming longitudinally extending transversely spaced indentations (25a).

3. The method set forth in claim 1 wherein said step of forming indentations comprises forming longitudinally and transversely spaced indentations (25b; 25c; 25d).

4. The method set forth in claim 3 wherein said indentations (25b; 25d) are in longitudinally aligned rows.

5. The method set forth in claim 1 wherein said step of forming said indentations (25c) comprises forming said indentations (25c) in one row such that they are staggered longitudinally with respect to indentations (25c) in an adjacent row.

Patentansprüche

1. Verfahren zur Herstellung eines Hochdruckkondensators bzw. -verflüssigers (20) mit einer Anzahl abgeflachter Rohre (21) mit zwei in Längsrichtung verlaufenden, gerundeten Rändern, deren Enden sich in Schlitze in einem Kopfteil (23) erstrecken, wobei die abgeflachten Rohre (21) durch Formwal-

zen von beiderseits beschichtetem, flachem Bandstreifenmaterial hergestellt sind, dadurch gekennzeichnet, daß

beabstandete Einbuchtungen bzw. Vertiefungen (25, 25a, 25b, 25c, 25d) in dem Bandstreifen geformt werden, und der Bandstreifen folgenden (Bearbeitungs)schritten unterworfen wird:

zunächst Walzen der entgegengesetzten Ränder bzw. Kanten des Bandstreifens in eine gerundete Konfiguration mit einem Radius, der dem gewünschten Krümmungsradius an einem gerundeten Rand eines Rohrs entspricht,

nachfolgend fortschreitendes Walzen des Mittelteils des Bandstreifens in die gerundete Konfiguration, die längs des anderen Längsrandes des Rohrs erwünscht ist, wobei die gerundeten Randabschnitte und der Mittelteil zum genauen Zentrieren des Streifens verwendet werden, während er durch die aufeinanderfolgenden Formwalzen geführt wird,

nachfolgendes Erhitzen der beabstandeten freien Ränder des gewalzten Bandstreifens auf eine Temperatur, bei der die Ränder zusammenschmelzen, und Leiten derselben durch eine Führung, die stromaufwärts von und in unmittelbarer Nähe zu Quetschwalzen gelegen ist, zum Bilden einer oder mehrerer Schweißnähte zwischen ihnen, wobei die Führung so ausgestaltet ist, daß sie jeden freien Randabschnitt des Bandstreifens an lateral gegenüberliegenden Rändern desselben zu erfassen vermag,

zur Anlage bringen von einander gegenüberliegenden Vorsprüngen im Bandstreifen und

Einbau der Rohre (21) mit den Rippen (22) in die Kopfteile (23), wobei die Enden der Rohre (21) sich in Schlitze in die Kopfteile (23) erstrecken,

Erhitzen der gesamten Baueinheit, um zu bewirken, daß die Beschichtung auf den Rohroberflächen die Vorsprünge miteinander, das Rohräußere mit den Schlitzen in den Kopfteilen (23), in welche sich die Rohre (21) erstrecken, und die Rippen (22) an den Rohren (21) verbindet.

2. Verfahren nach Anspruch 1, wobei der Schritt der Formung von Einbuchtungen die Formung in Längsrichtung verlaufender, in Querrichtung beabstandeter Einbuchtungen (25a) umfaßt.

3. Verfahren nach Anspruch 1, wobei der Schritt der Formung von Einbuchtungen die Formung in Längsrichtung und in Querrichtung beabstandeter Einbuchtungen (25b, 25c, 25d) umfaßt.

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4. Verfahren nach Anspruch 3, wobei sich die Ausbuchtungen (25b, 25d) in in Längsrichtung ausgerichteten Reihen befinden.

5. Verfahren nach Anspruch 1, wobei der Schritt der Formung der Einbuchtungen (25c) die Formung der Einbuchtungen (25c) in einer Reihe umfaßt, und zwar derart, daß sie in Längsrichtung gegenüber Einbuchtungen (25c) in einer benachbarten Reihe versetzt sind.

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Revendications

1. Un procédé de formage d'un condenseur à haute pression (20) comprenant une pluralité de tubes aplatis (21) ayant deux bords arrondis s'étendant longitudinalement, dont les extrémités s'étendent dans des fentes ménagées dans un collecteur (23), de manière que les tubes aplatis (21) soient constitués à partir de matériau en bande plate formés en rouleaux, présentant un revêtement sur les deux surfaces, le procédé étant caractérisé par :

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la formation d'indentations espacées (25; 25a, 25b, 25c, 25d) dans ladite bande, le passage de ladite bande par les étapes consistant à :

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premièrement rouler les bords opposés de la bande en configuration incurvée avec un rayon correspondant au rayon de courbure souhaité, sur un bord arrondi d'un tube, puis rouler progressivement la partie centrale de la bande en configuration arrondie, souhaitée, sur l'autre bord longitudinal du tube, tout en utilisant les parties à bords arrondis et la partie centrale pour centrer précisément la bande lorsqu'elle est avancée par les rouleaux de formage successifs,

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ensuite chauffer les bords libres espacés de la bande enroulée à une température à laquelle les bords vont fondre conjointement et les faire passer par un guide monté en amont de et directement adjacent à une paire de rouleaux de pressage, afin d'effectuer un ou plusieurs cordons de soudure entre eux, le guide étant conçu pour venir en contact avec chaque partie de bordure libre de la bande, sur des bords latéralement opposés de celle-ci, mettre en contact de butée des saillies opposées se trouvant dans la bande,

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et assembler les tubes (21, équipés des ailettes (22), sur les collecteurs (23), les extrémités des tubes (21) s'étendant dans les fentes ménagées dans les collecteurs (23),

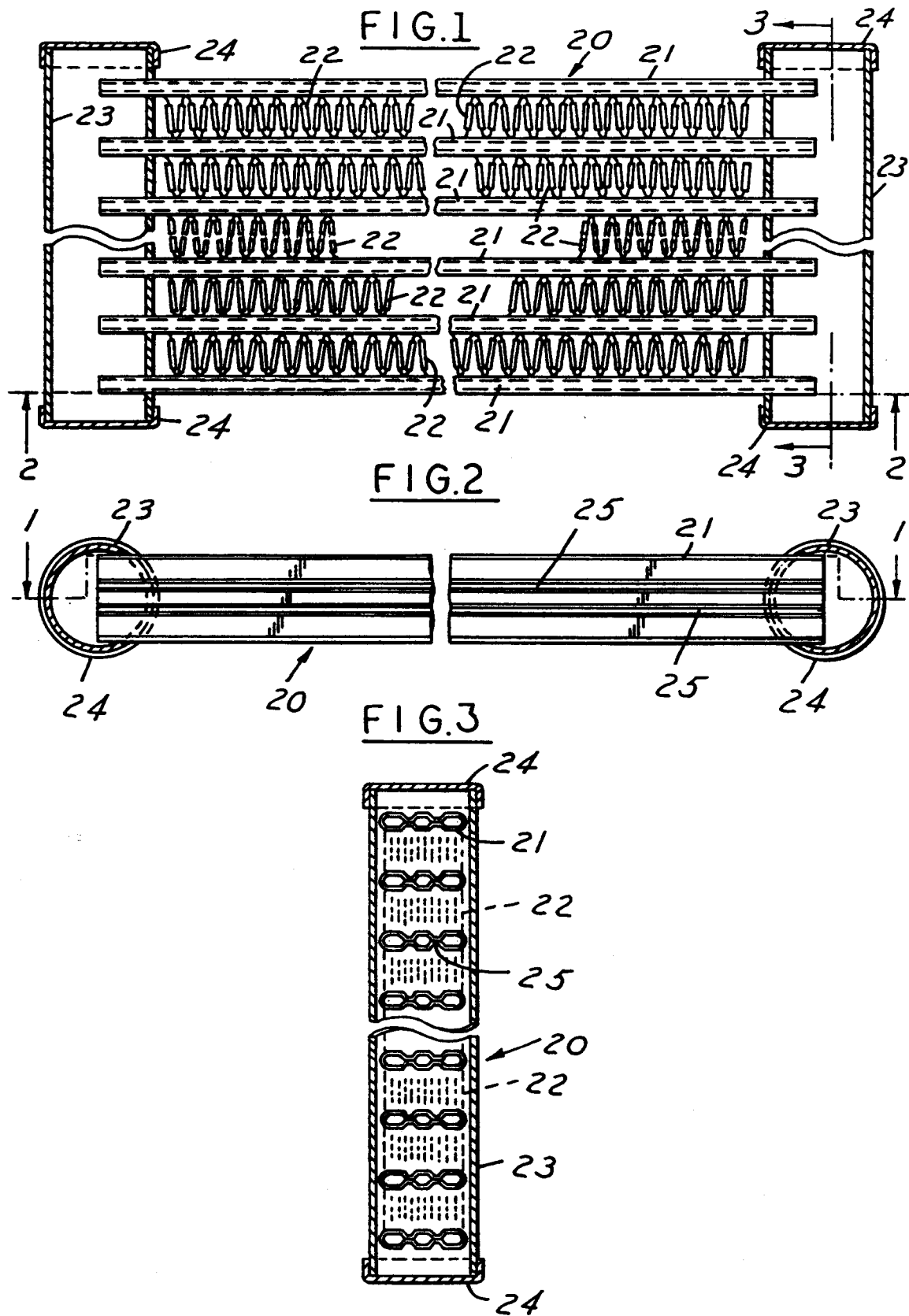
soumettre la totalité de l'ensemble à une exposition à la chaleur pour provoquer le revêtement appliqué sur les surfaces des tubes, de manière à lier les saillies les unes aux autres, à lier la partie extérieure des tubes aux fentes ménagées dans les collecteurs (23) à travers lesquelles les tubes (21) s'étendent et à lier les ailettes (22) dans les tubes (21).

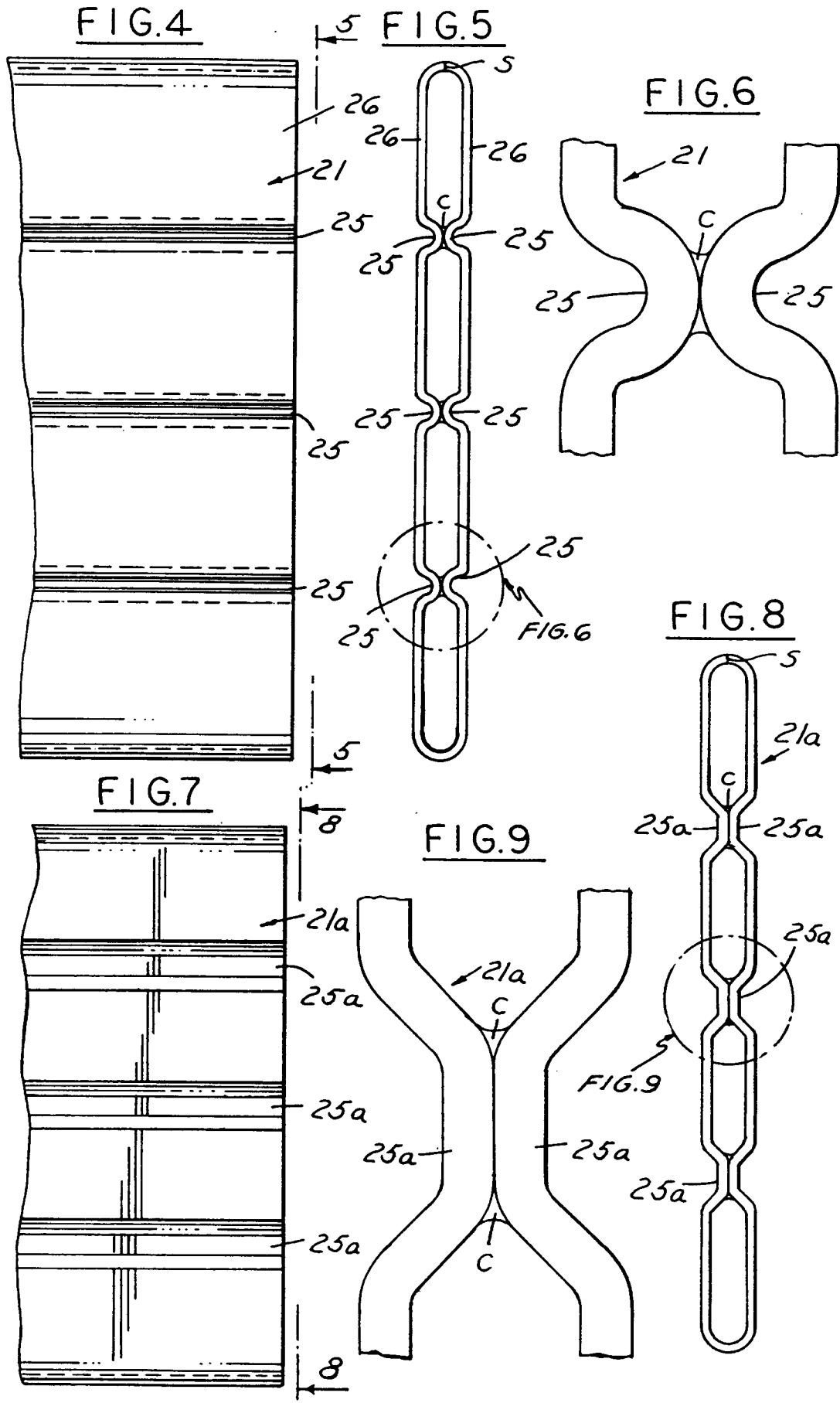
2. Le procédé selon la revendication 1, dans lequel ladite étape de formation d'indentations comprend la formation d'indentations (25a) espacées transversalement et s'étendant longitudinalement.

3. Le procédé selon la revendication 1, dans lequel ladite étape de formation d'indentations comprend la formation d'indentations (25b, 25c, 25d) espacées longitudinalement et transversalement.

4. Le procédé selon la revendication 3, dans lequel lesdites indentations (25; 25d) sont placées en rangées alignées longitudinalement.

5. Le procédé selon la revendication 1, dans lequel ladite étape de formation desdites indentations (25c) comprend la formation desdites indentations (25c) en une rangée de manière qu'elles soient en quinconce longitudinalement par rapport aux indentations (25c) se trouvant dans une rangée adjacente.





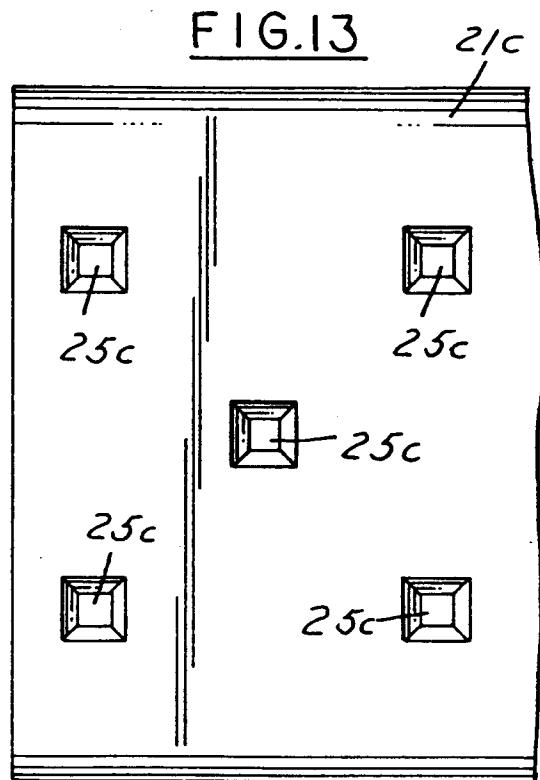
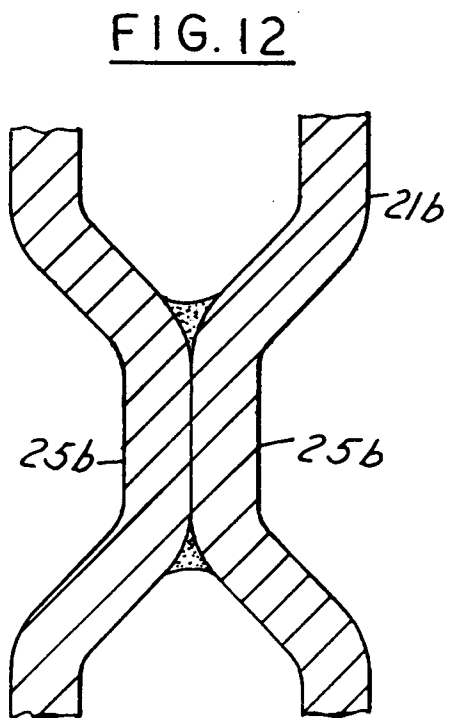
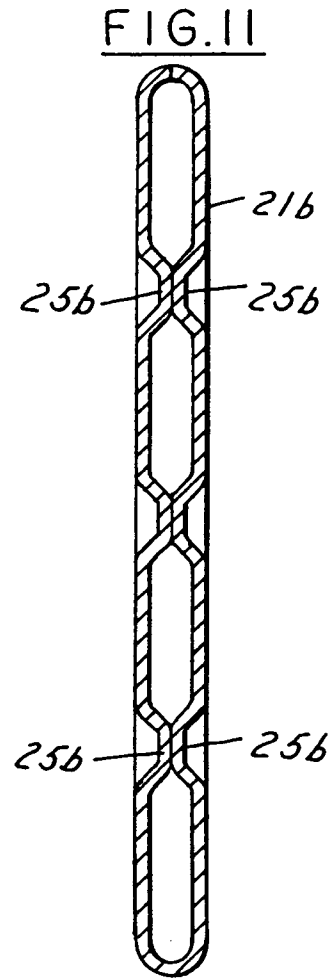
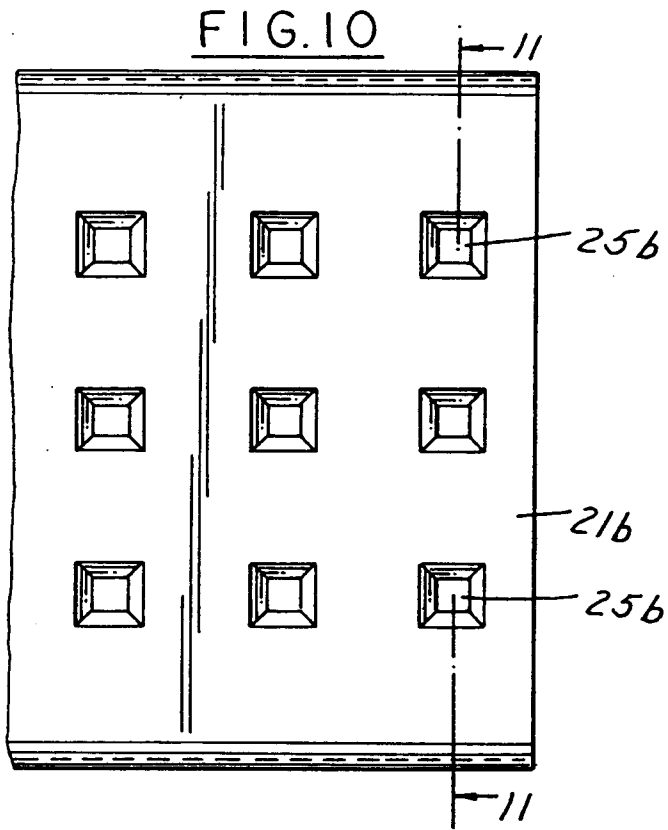


FIG. 14

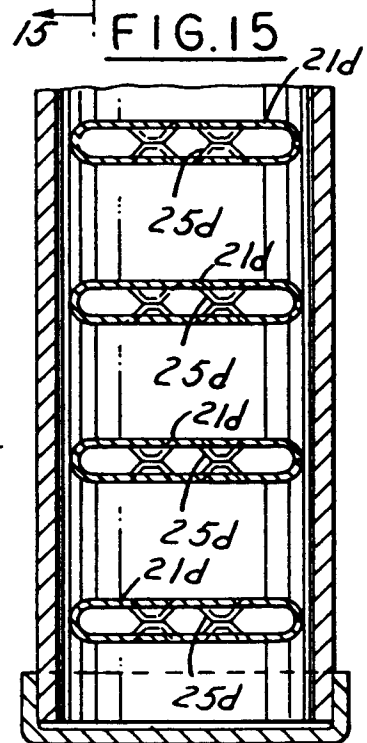
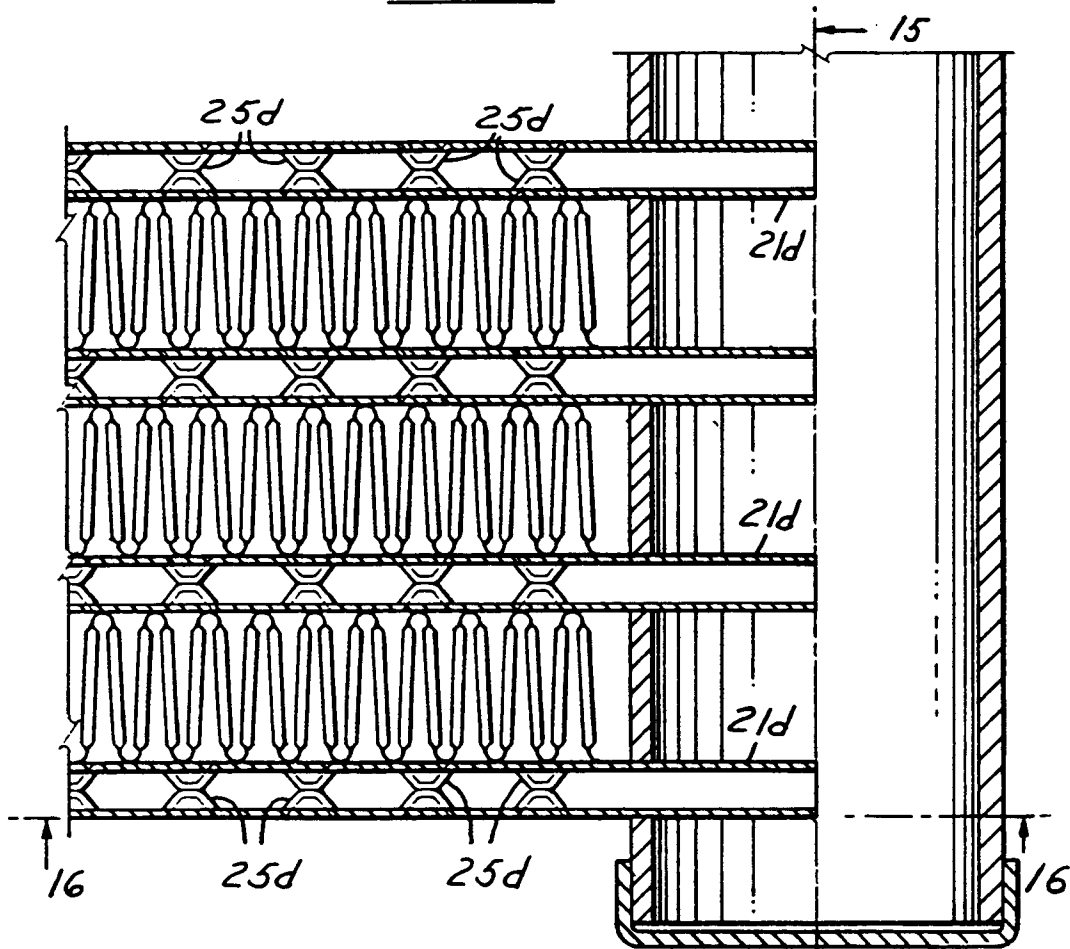


FIG. 16

